

## CLAIMS

We claim:

- 1     1.     A method in a network element comprising:  
2             converting Point to Point Protocol (PPP) protocol data units (PDUs) encapsulated  
3                     according to different protocols into PPP PDUs with a uniform  
4                     encapsulation; and  
5             transmitting the uniformly encapsulated PPP PDUs.
  
- 1     2.     A method in a network element comprising:  
2             using a Point to Point Protocol over Ethernet (PPPoE) session identifier to track a  
3                     first flow of PPP protocol data units (PDUs) encapsulated with a non-  
4                     Ethernet protocol;  
5             converting each PDU of the first flow of PPP PDUs into PPPoE PDUs; and  
6             converting each of a flow of PPPoE PDUs with the session identifier into a second  
7                     flow of PPP PDUs encapsulated with the non-Ethernet protocol.
  
- 1     3.     A method in a network element comprising:  
2             obtaining a Point to Point Protocol over Ethernet (PPPoE) session identifier for a  
3                     first flow of PPP protocol data units (PDUs) that are encapsulated with a  
4                     non-Ethernet protocol, wherein the flow of PPP PDUs are received over a  
5                     first port;  
6             converting each PPP PDU of the first flow into a flow of PPPoE PDUs;  
7             tracking the converted first flow; and  
8             transmitting the flow of converted PPPoE PDUs via a second port;  
9             converting each of a flow of PPPoE PDUs received via the second port into a  
10                     second flow of PPP PDUs of the non-Ethernet protocol, wherein the flow  
11                     of PPPoE PDUs received via the second port corresponds to the obtained  
12                     PPPoE session identifier.

1     4.     A network element comprising:  
2           a link layer port to receive link layer traffic encapsulated according to a link layer  
3           protocol;  
4           a link layer demultiplexer to demultiplex link layer traffic received via the link  
5           layer port into Point to Point Protocol over Ethernet (PPPoE) traffic, PPP  
6           over non-Ethernet (PPPoX) traffic, and non-PPP traffic;  
7           a virtual router coupled with the link layer demultiplexer, to forward non-PPP  
8           traffic received from the link layer demultiplexer;  
9           a Point to Point Protocol (PPP) switch module having,  
10           a PPPoX proxy module to convert PPPoX traffic received from the link  
11           layer demultiplexer into PPPoE traffic and to convert PPPoE traffic  
12           received from a PPPoE multiplexer/demultiplexer into PPPoX  
13           traffic;  
14           a PPPoE switch module to switch PPPoE traffic received from the link  
15           layer demultiplexer and from the PPPoE  
16           multiplexer/demultiplexer; and  
17           a PPPoE multiplexer/demultiplexer coupled with the PPPoX proxy module  
18           and the PPPoE switch module, the PPPoE  
19           multiplexer/demultiplexer to multiplex PPPoE traffic received from  
20           the PPPoE switch module and the PPPoX proxy module and to  
21           demultiplex PPPoE traffic into different traffic flows according to  
22           their session identifier.

1     5.     A network comprising:  
2           a first network element  
3           receiving a set of one or more flows of Point to Point Protocol over non-  
4           Ethernet (PPPoX) traffic via a first port,

5 obtaining a Point to Point Protocol over Ethernet (PPPoE) session  
6 identifier for each of the set of flows of PPPoX traffic,  
7 converting each of the set of flows of PPPoX traffic into different flows of  
8 PPPoE traffic in accordance with their session identifiers,  
9 multiplexing the different flows of PPPoE traffic,  
10 transmitting the multiplexed PPPoE traffic via a second port; and  
11 a second network element coupled with the first network element, the second  
12 network element receiving the multiplexed PPPoE traffic and terminating  
13 each of the different flows of PPPoE traffic.

1 6. A network comprising:  
2 a set of one or more service provider points of presence (PoPs) receiving traffic  
3 that includes Point to Point Protocol over non-Ethernet traffic on a set of  
4 one or more subscriber side flows and tunneling the traffic through a  
5 network cloud;  
6 a PoP Major of the service provider coupled with the network cloud, the PoP  
7 Major receiving the traffic and transmitting the traffic as PPP over  
8 Ethernet traffic along a single relatively inexpensive media; and  
9 an aggregator coupled with the PoP Major, the aggregator processing the PPPoE  
10 traffic.

1 7. A set of one or more machine-readable medium that provides instructions, which  
2 when executed by a set of one or more processors, cause said set of processors to perform  
3 operations comprising:  
4 converting Point to Point Protocol (PPP) protocol data units (PDUs) encapsulated  
5 according to different protocols into PPP PDUs with a uniform  
6 encapsulation; and  
7 transmitting the uniformly encapsulated PPP PDUs.